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Research Article
Race Composition of *Meloidogyne* Species Infecting *Pseuderanthemum atropurpureum* in Aligarh District of Western Uttar Pradesh

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Abstract

Objective: The aim of the present study was to evaluate the different races infecting *P. atropurpureum* so that the management practices can be followed as per the races of the nematodes. **Methodology:** A survey was conducted in 15 different places of Aligarh district of Western Uttar Pradesh to access the different races of *Meloidogyne* spp., infecting an ornamental pant *Pseuderanthemum atropurpureum*. Out of 70 isolates of *Meloidogyne* spp., collected from the roots of *P. atropurpureum* growing in different localities of Aligarh district, 14 isolates were designated as race-1, 36 isolates as race-3 and 5 isolates as race-4 of *M. incognita*. The remaining 15 isolates showed the presence of *M. arenaria* race-1 in 3 isolates and *M. arenaria* race-2 in 12 isolates. **Results:** The results of the present study showed that *P. atropurpureum* was more susceptible host to *M. incognita* as compared to *M. arenaria*. To the best of my knowledge, since no records are available in the literature regarding the infection of root-knot nematodes viz., *M. incognita* and *M. arenaria* and their race identification in *P. atropurpureum*. **Conclusion:** It is worthy to note that this plant may be considered as new host to the different races of *M. incognita* and *M. arenaria*.

Key words: Race composition, *M. incognita*, *M. arenaria*, *P. atropurpureum*

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Competing Interest: The authors have declared that no competing interest exists.

Data Availability: All relevant data are within the paper and its supporting information files.

INTRODUCTION

Plant parasitic nematodes have been recognized as one of the limiting factors in the normal production of agricultural and horticultural crops including ornamental plantation all over the world. Extent of damages, however, varies depending upon the nematode, crop and its cultivars, agro climatic conditions and other biotic and abiotic factors. Among the plant parasitic nematodes the root-knot nematodes, *Meloidogyne* spp., have been of interest to nematologists worldwide probably due to their widespread distribution and being most serious agricultural pests, which are responsible for heavy losses both in quantity as well as quality (Ogunfowora, 1977). The genus *Meloidogyne* comprises of about 97 described species and almost every kind of cultivated and wild plants are parasitized by one or the other species of root-knot nematodes (Hunt and Handoo, 2009). The knowledge about the occurrence of biological races in plant parasitic nematodes is essential and basic to studies of host-parasite relationships and to the success of plant breeding programmes for disease resistance. Increasing evidences indicate that every local population has a considerable amount of genetic variability according to host specificity. The results obtained with one population of a species should, therefore, be cautiously attributed to the other population of the same species. This situation has created problems for the taxonomists, plant breeders and other investigators because certain morphologically undistinguishable populations of a nematode species often produce different reactions on the same host. Thus, occurrence of intraspecific variations hamper our efforts to control plant parasitic nematodes through breeding resistant varieties and crop rotation.

Ritzema (1888) was probably the first to report that populations of *Ditylenchus dipsaci* collected from different plants showed host preferences and variations in pathogenicity. Such populations have been designated differently, such as races, strains, biological races, biotypes or pathogens etc. and the phenomenon as physiological specialization. The knowledge about biological races in nematodes has greatly increased in the last few decades and physiological variation has been observed in a considerable number of phytoparasitic nematodes (Sidhu and Webster, 1981; Dropkin, 1988). The aim of the present study was to evaluate the different races infecting *P. atropurpureum* so that the management practices can be followed as per the races of the nematodes.

MATERIALS AND METHODS

Seventy isolates of root-knot nematode (5 isolates from each locality) were randomly collected from the *P. atropurpureum* plants growing in different localities of Aligarh district of Uttar Pradesh. Out of these isolates, 55 isolates of *M. incognita* were collected from A.M.U. Campus, Akrabad, Atrauli, Bijuli, Chandaus, Chharra, Gangiri, Gonda, Hasangarh, Harduaganj, Jalali, Kasimpur, Khair, Raya and Tapal. Whereas, 15 isolates of *M. arenaria* were collected from Akrabad, Atrauli, Bijuli, Chandaus, Gangiri, Harduaganj and Kasimpur. Pure culture of these isolates were raised and maintained for the identification of races of *Meloidogyne* spp.

The identification of races of *M. incognita* and *M. arenaria* infecting *P. atropurpureum* grown in different localities of Aligarh district was made on the basis of their response to the differential host plants viz., cotton, Deltapine 61; tobacco, NC 95; pepper, Early California Wonder; peanut, Florunner and tomato, Rutgers as suggested by Hartman and Sasser (1985). Watermelon, Charleston Gray was not used in the race identification test, since it was a differential host of *M. hapla*. Twenty one days old cuttings of test plants grown in 6 inch clay pots containing 1 kg of sterilized soil/pot were inoculated with 2000 J_2 of either *M. incognita* or *M. arenaria* isolate. After 60 days of inoculation, the number of egg masses and galls per root system were counted and index prepared on the basis of following formula:

0 = No galls or egg masses
1 = 1-2 galls or egg masses
2 = 3-10 galls or egg masses
3 = 11-30 galls or egg masses
4 = 31-100 galls or egg masses
5 = More than 100 galls or egg masses

The host plants having an average gall and egg mass index of 2 or less were considered resistant (-), whereas, the plants with an average gall and egg mass index of more than 2 were considered susceptible (+). The data was compared with the following Table 1 as proposed by Taylor and Sasser (1978).

RESULTS AND DISCUSSION

The data presented in Table 2 showed that the two species of *Meloidogyne* viz., *M. incognita* and *M. arenaria* were found in the root samples of *P. atropurpureum*. The percentage of *M. incognita* infecting *P. atropurpureum*

Table 1: Response of races of *M. incognita* and *M. arenaria* to the North Carolina differential host test plants

Meloidogyne species and physiological races	Differential host plants				
	Cotton cv. Deltapine 61	Tobacco cv. NC 95	Pepper cv. Early California Wonder	Peanut cv. Florunner	Tomato cv. Rutgers
Meloidogyne incognita					
Race-1	-	-	+	-	+
Race-2	-	+	+	-	+
Race-3	+	-	+	-	+
Race-4	+	+	+	-	+
Meloidogyne arenaria					
Race-1	-	+	+	+	+
Race-2	-	+	-	-	+

*Resistant host, +: Susceptible

Table 2: Infection of *Meloidogyne* species on *Pseuderanthemum atropurpureum* at different places in Aligarh district of Western Uttar Pradesh

Locality	No. of infected plants examined	No. of plants infected with *Meloidogyne* species	
		Meloidogyne incognita	*Meloidogyne arenaria*
A.M.U. Campus	5	5	-
Akrabad	5	2	3
Atrauli	5	3	2
Bijuli	5	3	2
Chandaus	5	3	2
Chharra	5	5	-
Gangiri	5	3	2
Gonda	5	5	-
Harduaganj	5	3	2
Hasangarh	5	5	-
Jalali	5	5	-
Kasimpur	5	3	2
Khair	-	-	-
Raya	5	5	-
Tapal	5	5	-
Total No. of infected plants	70	55 (78.5)*	15 (21.4)
Average No. of root galls/plant	-	185.0	92.0
Average No. of egg masses/plant	-	115.0	65.0
Average No. of eggs/egg mass		210.0	115.0

*Figures in parentheses are the percentage of infected plants calculated against total No. of plants infected

plants growing in different localities of Aligarh district was highest (78.5%) as compared to *M. arenaria* where percentage of infection was 21.4%. This showed that among the *Meloidogyne* species *M. incognita* was most prevalent in comparison to *M. arenaria*. These results are also in agreement with some workers who also reported that the frequency of occurrence of root-knot disease caused by *M. incognita* was relatively greater than the root-knot disease caused by other species of *Meloidogyne* on different plants including ornamentals (Nath *et al*., 1996; Srivastava *et al*., 2012; Singh *et al*., 2012). However, these results are contradictory to the findings of other workers who observed the *M. javanica* as predominant species of *Meloidogyne* on some vegetables as well as on ornamental plants (Haseeb and Pandey, 1987; Das and Das, 2000; Esfahani, 2009; Sahu *et al*., 2011).

It was observed that there was no concomitant occurrence of *M. incognita* and *M. arenaria* in the roots of *P. atropurpureum*. Furthermore, the highest number of average root galls (185 galls/root system) and egg masses (115 egg masses/root system) were present in the plants infected with *M. incognita*. Whereas, the lowest number of root galls (92 galls/root system) and egg masses (65 egg masses/root system) were recorded in plants infected with *M. arenaria.* Similarly, the maximum number of eggs per egg-masses (210 eggs) was observed in the plants infected with *M. incognita* in comparison to 115 eggs/egg mass in the plants infected with *M. arenaria*. These results showed that *P. atropurpureum* was more susceptible host to *M. incognita* as compared to *M. arenaria*.

The results presented in Table 3 clearly revealed that out of 15 localities of Aligarh district, the infection of *M. incognita* on *P. atropurpureum* was found in all the localities except Khair. Whereas, the *M. arenaria* infection was observed in only 7 localities viz., Akrabad, Atrauli, Bijuli, Chandaus, Gangiri, Harduaganj and Kasimpur. The frequency of occurrence of *M. incognita* infection in *P. atropurpureum* plants was

Table 3: Occurrence of species and races of root-knot nematodes infecting *Pseuderanthemum atropurpureum* in Aligarh district of Western Uttar Pradesh

	Response of *Meloidogyne* spp., to host differential plants					
Locality	Cotton cv. Deltapine 61	Tobacco cv. NC 95	Pepper cv. Early California Wonder	Peanut cv. Florunner	Tomato cv. Rutgers	Species and race of *Meloidogyne*
A.M.U. Campus-1	+*	-*	+	-	+	*M. incognita*-3
A.M.U. Campus-2	+	-	+	-	+	*M. incognita*-3
A.M.U. Campus-3	+	-	+	-	+	*M. incognita*-3
A.M.U. Campus-4	+	-	+	-	+	*M. incognita*-3
A.M.U. Campus-5	+	-	+	-	+	*M. incognita*-3
Akrabad-1	+	-	+	-	+	*M. incognita*-3
Akrabad-2	+	-	+	-	+	*M. incognita*-3
Akrabad-3	-	+	-	-	+	*M. arenaria*-2
Akrabad-4	-	+	+	+	+	*M. incognita*-1
Akrabad-5	-	+	-	-	+	*M. arenaria*-2
Atrauli-1	+	-	+	-	+	*M. incognita*-3
Atrauli-2	-	-	+	-	+	*M. incognita*-1
Atrauli-3	+	-	+	-	+	*M. incognita*-3
Atrauli-4	-	+	-	-	+	*M. arenaria*-2
Atrauli-5	-	+	-	-	+	*M. arenaria*-2
Bijuli-1	-	+	-	-	+	*M. arenaria*-2
Bijuli-2	-	+	-	-	+	*M. arenaria*-2
Bijuli-3	-	-	+	-	+	*M. incognita*-1
Bijuli-4	+	-	+	-	+	*M. incognita*-3
Bijuli-5	+	-	+	-	+	*M. incognita*-3
Chandaus-1	+	-	+	-	+	*M. incognita*-3
Chandaus-2	-	-	+	-	+	*M. incognita*-1
Chandaus-3	+	-	+	-	+	*M. incognita*-3
Chandaus-4	-	+	+	+	+	*M. arenaria*-1
Chandaus-5	-	+	+	+	+	*M. arenaria*-1
Chharra-1	-	-	+	-	+	*M. arenaria*-1
Chharra-2	+	-	+	-	+	*M. incognita*-3
Chharra-3	+	-	+	-	+	*M. incognita*-3
Chharra-4	-	-	+	-	+	*M. incognita*-1
Chharra-5	-	-	+	-	+	*M. incognita*-1
Gangiri-1	+	-	+	-	+	*M. incognita*-3
Gangiri-2	+	-	+	-	+	*M. incognita*-3
Gangiri-3	+	-	+	-	+	*M. incognita*-3
Gangiri-4	-	+	-	-	+	*M. arenaria*-2
Gangiri-5	-	+	-	-	+	*M. arenaria*-2
Gonda-1	+	-	+	-	+	*M. incognita*-3
Gonda-2	+	-	+	-	+	*M. incognita*-3
Gonda-3	+	-	+	-	+	*M. incognita*-3
Gonda-4	-	-	+	-	+	*M. incognita*-1
Gonda-5	-	-	+	-	+	*M. incognita*-1
Harduaganj-1	+	-	+	-	+	*M. incognita*-3
Harduaganj-2	+	-	+	-	+	*M. incognita*-3
Harduaganj-3	+	-	+	-	+	*M. incognita*-3
Harduaganj-4	-	+	-	-	+	*M. arenaria*-2
Harduaganj-5	-	+	-	-	+	*M. arenaria*-2
Hasangarh-1	-	-	+	-	+	*M. incognita*-1
Hasangarh-2	-	-	+	-	+	*M. incognita*-1
Hasangarh-3	+	-	+	-	+	*M. incognita*-3
Hasangarh-4	-	+	-	-	+	*M. incognita*-4
Hasangarh-5	-	+	-	-	+	*M. incognita*-3
Jalali-1	+	-	+	-	+	*M. incognita*-3
Jalali-2	+	-	+	-	+	*M. incognita*-3
Jalali-3	+	-	+	-	+	*M. incognita*-3
Jalali-4	+	+	+	-	+	*M. incognita*-4
Jalali-5	+	-	+	-	+	*M. incognita*-3

Table 3: Continue

Locality	Response of *Meloidogyne* spp., to host differential plants: Cotton cv. Deltapine 61	Tobacco cv. NC 95	Pepper cv. Early California Wonder	Peanut cv. Florunner	Tomato cv. Rutgers	Species and race of *Meloidogyne*
Kasimpur-1	+	-	+	-	+	*M. incognita*-3
Kasimpur-2	+	+	+	-	+	*M. incognita*-4
Kasimpur-3	+	+	+	-	+	*M. incognita*-4
Kasimpur-4	-	+	-	-	+	*M. arenaria*-2
Kasimpur-5	-	+	-	-	+	*M. arenaria*-2
Raya-1	+	-	+	-	+	*M. incognita*-3
Raya-2	+	+	+	-	+	*M. incognita*-4
Raya-3	+	-	+	-	+	*M. incognita*-3
Raya-4	+	-	+	-	+	*M. incognita*-3
Raya-5	+	-	+	-	+	*M. incognita*-3
Tapal-1	-	-	+	-	+	*M. incognita*-1
Tapal-2	-	-	+	-	+	*M. incognita*-1
Tapal-3	-	-	+	-	+	*M. incognita*-1
Tapal-4	-	-	+	-	+	*M. incognita*-1
Tapal-5	+	-	+	-	+	*M. incognita*-3

-: Indicates a resistant host, +: Indicates a susceptible host

Table 4: Frequency of occurrence of races of *Meloidogyne* spp., infecting *P. atropurpureum* in Aligarh district of Western Uttar Pradesh

Races of *Meloidogyne* species								
Races of *Meloidogyne incognita*					Races of *Meloidogyne arenaria*			
R1	R2	R3	R4	Total No. of races of *M. incognita*	R1	R2	Total No. of races of *M. arenaria*	Total No. of races of *Meloidogyne* spp.
14 (20.0)	0 (0)	36 (51.4)	5 (7.1)	55	3 (4.2)	12 (17.1)	15	70

Figures in parentheses are the frequency of occurrence of races of *Meloidogyne* sp., calculated against total No. of races of *Meloidogyne* spp.

greater than the *M. arenaria.* Among the races of *M. incognita* recorded in *P. atropurpureum*, the race-3 of *M. incognita* was present in 14 examined localities of Aligarh district viz., A.M.U. Campus, Akrabad, Atrauli, Bijuli, Chandaus, Chharra, Gangiri, Gonda, Hasangarh, Harduaganj, Jalali, Kasimpur, Raya and Tapal. The race-1 was present in 7 localities viz., Atrauli, Bijuli, Chandaus, Chharra, Gonda, Hasangarh and Tapal. Whereas, race-4 was observed in only 4 localities viz., Hasangarh, Jalali, Kasimpur and Raya. Among the races of *M. arenaria*, the race-2 was present in 6 localities viz., Akrabad, Atrauli, Bijuli, Gangiri, Harduaganj and Kasimpur and race-1 of *M. arenaria* was present only in two localities viz., Chandaus and Chharra.

Out of 70 isolates of *Meloidogyne* spp., collected from the roots of *P. atropurpureum* growing in different localities of Aligarh district, 14 isolates were designated as race-1, 36 isolates as race-3 and 5 isolates as race-4 of *M. incognita*. The remaining 15 isolates showed the presence of *M. arenaria* race-1 in 3 isolates and *M. arenaria* race-2 in 12 isolates. Among the races of *M. incognita,* the highest frequency of occurrence was recorded in race-3 (51.4%), followed by race-1 (20%) and race-4 (7.1%). However, on the other hand, among the races of *M. arenaria,* the frequency of occurrence of race-2 and race-1 was observed as 17.1 and 4.2%, respectively (Table 4). These results are also in agreement with Khan and Khan (1991), who observed the race-2 of *M. arenaria* as most prevalent species in vegetable fields in eight districts of Uttar Pradesh including Aligarh. Similarly Sasser (1980) recorded *M. arenaria* race-2 as the most frequently encountered than race-1 on worldwide basis.

CONCLUSION

The present investigations have clearly indicated the association of some important plant parasitic nematodes like *M. incognita* and *M. arenaria* are highly pathogenic in nature. Their occurrence in high densities may pose a serious threat to *P. atropurpureum*, if the management practices are not being governed to keep the populations under check. Therefore, it needs immediate attention of growers and researchers to manage the damage caused by the nematode and fungus on *P. atropurpureum*.

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